POLARIMETRIC FAR-INFRARED OBSERVATIONS OF SAGITTARIUS B2

FINAL TECHNICAL REPORT, COVERING THE PERIOD OCTOBER 1990 TO JULY 1991

The Five College Radio Astronomy Observatory
Department of Physics and Astronomy
619 Lederle Graduate Research Center
University of Massachusetts
Amherst MA 01003

Principal Investigator: Giles Novak

N.A.S.A. Technical Officer : Curtis D. Laughlin
Medium Altitude Missions Branch 211-12
Ames Research Center
Moffett Field, CA 94035

Grant Agreement Number : NAG 2-676

submitted: September 1991

The completion of this research project was interrupted when I (Giles Novak) resigned from my position at the U. of Massachusetts, in July 1991. I now work at Princeton University, and have submitted a new propsal to N.A.S.A. in order to complete the work which I started at the U. of Massachusetts. The original U. of Massachusetts proposal had two goals: (1) To study the magnetic field configuration in the bright Galactic Center cloud Sagittarius B2, using the U. of Chicago far-infrared array polarimeter, and (2) to build an instrument rotator for the Chicago polarimeter. In this final report, we present observations of Sagittarius B2 made from the K.A.O. in June '91, and discuss ongoing work on the interpretation of these data. We also discuss progress which has been made on the construction of the instrument rotator. A more full discussion of these points, as well as a proposed budget and schedule for the completion of the project from Princeton, are given in the new (Princeton) proposal, also submitted in Sept. 1991.

The U. of Massachusetts proposal was awarded two K.A.O. flights. During a single flight in June '91 we obtained more 100 μm polarimetric measurements (13) than had been obtained previously for any cloud. We discovered a dramatic rotation of the direciton of polarization. We saw two magnetically distinct regions in Sgr B2, one towards the East (with polarization in the East-West direction) and one towards the West (with polarization at a position angle of 30 degrees East from North). Within each region, the inferred magnetic field direction is apparently quite uniform.

Some insight into the nature of these two distinct "magnetic regions" has been gained by comparing our polarization map with a 1300 μm continuum map of the same region. The total dust column density in Sgr B2 is traced by the 1300 μm emission. The region of Sgr B2 with polarization at position angle 30 degrees is found to correspond to the dense core of Sgr B2, while the region with nearly East-West polarization corresponds to the less dense envelope of Sgr B2.

A field which is constant in direction must be constant in magnitude. It would thus appear from our observations that the field in the core of Sgr B2 is constant in strength throughout the core. Given the large gradients in density which characeterize the core of Sgr B2, a uniform field is very difficult to understand. During the gravitational collapse of a cloud, a frozen-in field would be expected to increase in strength as the density increases.

The simplest conclusion which we can draw from the uniform field we observe is that the core of Sgr B2 formed by ambipolar diffusion. This would contradict the theoretical picture of star formation proposed by Shu and collaborators which holds that massive cloud cores form by magnetically supercritical cloud contraction, while low-mass cores are magnetically subcritical and thus form by ambipolar diffusion.

I plan to continue the interpretation of these data from Princeton, and hope that a make-up flight in Summer '92 is possible. Next summer we will have several factors working in our favor: The Chicago polarimeter will have twice as many beams (32 vs. 16), and it should have higher spatial resolution (35" vs. 50"), as a result of better registration beteen the two arrays. Higher resolution will be critical in studying the core of Sgr B2.

The mechanical construction of the instrument rotator has been essentially finished: The rotator was operated sucessfully aboard the K.A.O. in June '91, and was a key ingredient in the sucess of this observing run. The rotator is not yet computerized, however.

Of the $65,000 which was originally awarded for this research project, I have spent approximately $23,000. The University of Massachusetts has closed out this account, and the accounting office at the U. of Mass. is preparing the Final Financial Report. I have, in my new proposal, asked for the funds necessary to finish the project from Princeton University.